Iowa Farm Science

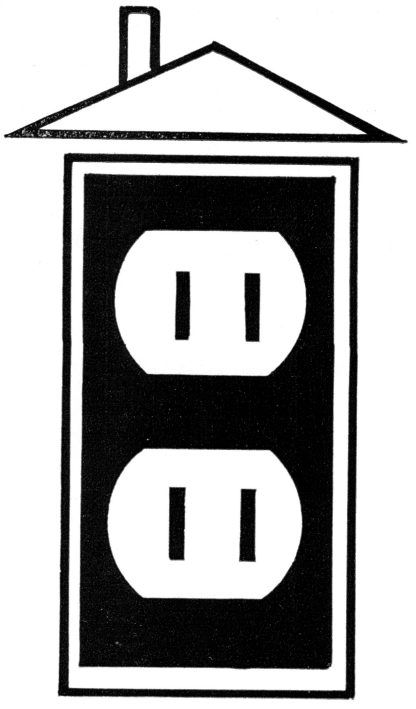
Volume 22 | Number 4 Article 8

10-1967

Home Wiring Needs

Helen J. Van Zante
Iowa State University

Virginia Harding
Iowa State University



HOME WIRING NEEDS

By Helen J. Van Zante and Virginia Harding

MOST HOUSES wired before 1950 are not equipped to take the electrical demand made on them today.

Just count the number of appliances you've acquired since then. There are hair dryers, blenders, rotisseries, air conditioners, dehumidifiers, humidifiers, automatic garage doors, can openers, stereos, television—just to name a few. Some of these were not on the market in 1950—yet many homes today are supplied with all of them plus the standbys they had before.

What does this do to your electrical wiring system? It's like putting a Cadillac motor in an antique car. The antique just couldn't stand the strain. It would be a hazard to ride in—the same as your house wiring isn't safe with the big demand you're asking of it.

Look around your house if you don't think you're asking too much. Do you have extension cords plugged three deep into any outlet in the room? Do the lights dim when your iron clicks on? Or does the TV picture flutter and shrink when other appliances go into operation? Do fuses blow or circuit breakers require resetting frequently?

If these things have been happening in your house, you'd better rewire—or, increase your fire insurance. Any way you look at it—it's dangerous.

To see if your house is adequately wired, check it for the answers to these five questions:

- **Is the electric supply coming into the house big enough to handle your wattage load?**
- **Is your power distribution center of a capacity to handle this supply?**
- **Do the number of circuits in your house at least meet minimum Federal Housing Administration (FHA) standards?**
- **Do your lights and convenience outlets at least meet minimum FHA standards?**
- **Is your wire of adequate size to handle the load expected of it?**

HELEN J. VAN ZANTE is former associate professor of household equipment and is now at Auburn University, Auburn, Alabama; VIRGINIA HARDING is assistant extension editor.

Electric Supply

Let's take these questions one at a time. First, the electrical supply needed. This will take some figuring on your part to determine what wattage load you are using in your house.

Every light, every small appliance and every major piece of electrical equipment uses watts. Each item usually has the number of watts imprinted on it somewhere or the amps and volts are given making it possible for you to calculate the wattage (Watts=amps $\times$volts). Voltage is either 230 to 240, or 115 to 120.

Copy the wattage from each piece of equipment and each bulb then total it up to determine your wattage load. If this seems too difficult to do, we've supplied a list of wattages for most pieces of equipment in Table 1. Use these if you cannot locate the stated wattage for your particular appliances or equipment.

To determine the number of amperes of electricity you need to bring into the house to cover your total wattage load, again use the formula: Amperes=watts divided by volts. Divide the watts you added up from all appliances and lights by 230 volts, the supply voltage in the modern home. This answer is the number of amperes that would be coming into your house, if all lights and appliances were turned on at the same time. Since it is not likely to happen, it is not absolutely necessary to supply the maximum amperage. However, one should allow more than the minimum amperage for future additions.

The average house built today has a 100 ampere service. Yet many houses need 200 amperes or more to handle the electrical load. If you do not know the size of the electrical service coming into your house ask your electrician. He can tell by the size of the lead-in wires. Table 2 gives the wire size, the number of amperes it would carry and the wattage load it would handle.

Power Distribution Center

Selection of a power distribution center is much more important than

the thought you put into buying a new appliance.

It must have sufficient capacity to take care of the wattage need of your home. Also, it should be designed to handle the types and number of branch circuits needed. And it should also be able to accommodate at least one more circuit that you may need to add in the future.

You have two choices in distribution centers: one containing fuses or one containing circuit breakers. Both can be adequate but of the two, the circuit breaker box is more convenient (no hunting for fuses) and more "foolproof" (no possibility of misusing fuses).

Circuit breaker boxes include a main breaker of at least 100 amperes and sub-breakers for each of the sub-circuits. A minimum of six breaker handles can substitute as a main disconnect.

When a circuit is overloaded, the breaker switch for that circuit will flip off. Once the source of trouble is corrected, to restore the service, first push the breaker to extreme "off" position, then back to the "on" position. This may require a few minutes before the electricity will come back on as the breaker has to cool before it will connect again. Breakers sometimes stick. To prevent this happening, reset them occasionally to make sure they are not corroding into a fixed position.

Whichever type of power distribution center you choose—fuse box or circuit breaker—locate it inside the house where it's handy to get to for servicing. Near the back door may be a good spot or near the electric meter. It is frequently located in the basement.

Circuits

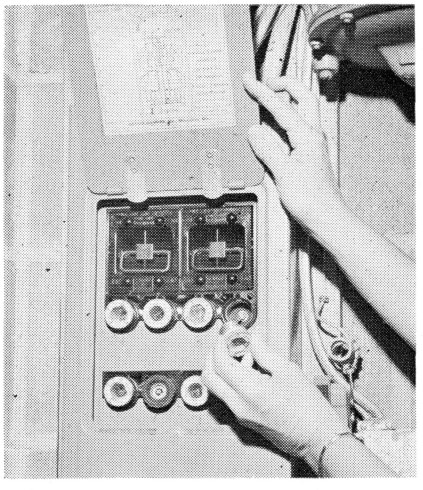
From the power distribution center, branch circuits are run to various outlets. Check the FHA standards on these but don't be limited by them. The number of circuits in your home depends on the amount of equipment and lights you have to use. And you need to consider what you might be adding later. You'll need varying sizes, depending on your equipment. For 120 voltage use, you'll need—

- **for lights—several 15 amp. circuits (very often 20 amp circuits are used)**
- **for ironing, small cooking equipment, freezer, refrigerator and small appliances — several 20 amp. circuits (five or six)**

For 240 voltage use, you'll need—

- **for a range—a special 50 amp. circuit**
- **for a water heater—a special 30 amp. circuit**
- **for a clothes dryer—a special 30 amp. circuit**
- **for an air conditioner—a special 30 amp. circuit**

So that the lights won't go out all over a room when one circuit "blows," have your circuits cross over from one room to another.



A FUSE BOX can provide an adequate distribution center in the modern home's electrical system.

Latest National Electric Code regulations recommend the use of grounded wire to each house circuit. For example, any 20 amp. circuit could be made up of Romex 12-2-G or GR which would contain three wires, one being a ground.

Back at the power distribution center, all of the ground wires are connected to a water pipe. When grounding in this way a jumper wire needs to be attached across the water meter in case the meter itself might be removed for some reason.

Rural Electric Cooperative and some other companies use a different grounding system. They require a separate metal rod inserted far enough into the ground to reach wet soil as their grounding rod. For exact specifications on this matter consult the power distributor.

FHA Standards for Circuits

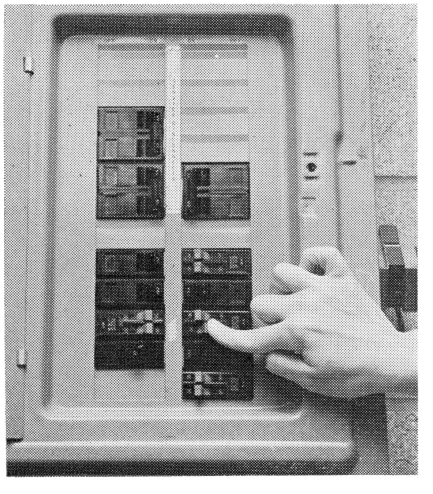
The Federal Housing Administration has set certain standards to use as guides for adequate housing. Those items they've indicated for *minimum* electrical requirement make a good guide for all home owners to use. Use this only as a starting point—these are *minimum standards* and your needs may be greater already because of the equipment you have and the use you make of it.

Circuits to kitchen, dining and laundry areas should include:

- *At least two 20 amp. circuits to serve receptacle outlets. (The average home, however, could use three or four appliance circuits to service these areas.)*
- *Individual branch circuits to comply with National Electric Code for fixed appliances or equipment rated at more than 1400 watts (range, dryer, air conditioner).*

Circuits to lighting outlets should consist of:

- *For the first 500 square feet of floor space, not counting kitchen, bathroom and laundry outlets—two 15 amp. circuits.*
- *For each additional 500 square feet of floor space—one additional 15 amp. circuit.*
- *Service entrance panel of size to allow at least one more cir-*



A CIRCUIT BREAKER is the other choice for the electrical distribution center. It is considered more convenient and "foolproof."

cuit to be added later unless the number of circuits already planned is more than the minimum stated above. (We recommend space for several more.)

Electricity Where You Want It

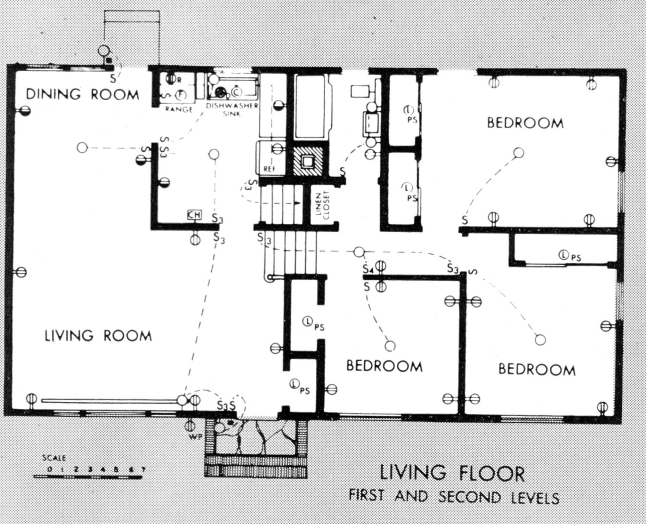
The end product–the lights or the convenience outlets–is where most homemakers start thinking about their electrical living. And perhaps it's not a bad place to start because this determines the load that the wire, circuits and the power distribution center must handle.

But whether you're building new, inspecting a house to buy or just re-evaluating the electrical system in the house you're living in today, be sure it is wired for both safety and convenience. Unfortunately, there's no state-wide safety inspection in Iowa and many small towns as well as rural homes may not have such protection unless they've made the effort to have inspection done themselves.

FHA Standards for Outlets:

Number of outlets:

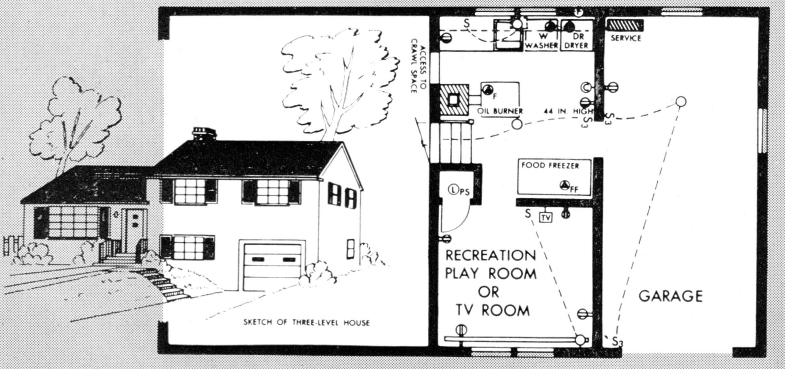
- *A receptacle every 12 feet plus an outlet between all doors, and doors and fireplace if there's space for furniture. (This number of outlets is considered moderate by many specialists and additional outlets are desirable.)*
- *In the kitchen–at least two duplex outlets of the grounding type over work counters. (We recommend more.)*
- *In bathrooms–one outlet adjacent to the mirror or included in the light fixture next to the mirror.*
- *In rooms where there are no permanent ceiling or wall lighting fixtures–a minimum of three outlets.*
- *In laundry area–an outlet of the grounding type. (We recommend more.)*
- *In basements, garages, open porches, breezeways or other locations used by persons standing on the ground or on grounding conductive materials–outlets of the grounding type. (Use weatherproof outlets outdoors.)*



LIVING FLOOR
FIRST AND SECOND LEVELS

A good plan for electrical use in one of today's split-level house plans is reproduced above from the American Standard Requirements for Residential Wiring. Guides for reading the symbols for the electric wiring plans are:

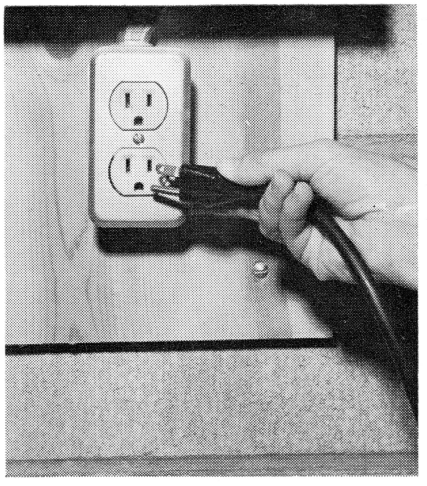
- Lighting Outlet
- Continuous Wireway for Fluorescent Lighting
- Lighting Outlet with Lamp Holder and Pull Switch
- Fan Outlet
- Clock Outlet
- Duplex Convenience Outlet
- Duplex Convenience Outlet–Split Wired
- Weather Proof Convenience Outlet
- Range Outlet
- Special Purpose Outlet
- Single-Pole Switch
- Three-Way Switch
- Four-Way Switch
- Chime
- Television Outlet
- Service Panel



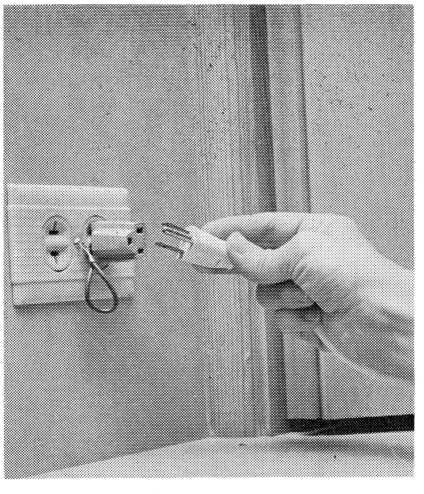
BASEMENT

TABLE 1. Wattage check-list.

Appliance	Wattage
Air conditioner (central)	6,000
Air conditioner (room)	1,500
Bed covering (electric)	170
Broiler (separate from range)	1,500
Can opener	150
Clock	2
Clothes dryer	5,000
Coffee maker	650-1,500
Deep fat fryer	1,350
Dehumidifier	300
Dishwasher	1,200
Fan (attic)	375
Fan (floor circulator & portable)	100-150
Fan (kitchen exhaust)	100
Floor polisher	300
Fry pan	1,200
Freezer	500
Furnace blower	600
Garage door	125
Grill	800
Hair dryer	375
Heating pad	60
Iron (steam or dry)	1,100
Ironer	1,650
Juice extractor	300
Knife	85
Knife sharpener	100
Mixer (small portable)	75
Mixer (counter top)	175
Radio	80
Range (separate built-in oven)	5,000
Range (separate 2-units)	3,400
Range (separate 4-units)	6,800
Range (4 units + 1 oven)	12,000
Range (4 units + 2 ovens)	16,000
Range (electronic oven unit without broiler)	2,500
Record player	100
Refrigerator (manual defrost)	300
Refrigerator (frostless)	425
Refrigerator-Freezer	330
Roaster	1,500
Rotisserie	1,350
Sewing machine	75
Shaver	15
Space heater (portable)	1,350-1,700
Space heater (built-in)	1,500-2,500
Sunlamp	500
Television	300
Toaster	1,000
Vacuum cleaner (tank-type)	750
Vacuum cleaner (upright)	350
Waffle baker	1,000
Washer (automatic)	500
Washer-Dryer combination	4,500
Water heater	5,000
Water heater (quick recovery)	9,000
Workbench equipment (saws, drills, etc.)	1,200



GREATER SAFETY from shock is provided by the new three-prong outlets and plugs shown here. The three-prong plug grounds the appliance through a central grounding system. The three-prong outlets are used with a third wire in the wiring system.



APPLIANCES also can be grounded with a pig-tail wire from an adapter used to allow use of three-prong plugs with the older style outlets. In this case, the receptacle must be grounded so the central screw on the plate is also grounded.

Grounding type of outlets are those that have receptacles that can receive three-prong appliance plugs. Such receptacles should be grounded through a third-wire grounding system. Thus, the new appliances with three-prong plugs always have the advantage of being grounded in this type outlet.

FHA Standards for Lighting and General Use

- *In kitchens, dining rooms, bathrooms and halls—permanent lighting fixtures that are wall switch controlled.*
- *In other habitable rooms (living rooms, bedroom, etc.)—either permanent lighting fixtures, wall switch controlled, or switch controlled receptacle outlet(s).*
- *At main and service doorways—outside fixture with interior wall switch control.*
- *On stairways connecting habitable rooms or halls at different elevations – permanent lighting fixtures that are multiple switch controlled from each elevation.*
- *Basement stairs – permanent lighting fixtures, switch controlled from the head of the basement stairs. If other exit doorways are in the basement, then have multiple switch control at both elevations.*
- *Utility rooms and other areas requiring general illumination—permanent lighting fixtures that provide ample light.*
- *Garage, attic, basement—number and type and location of outlets acceptable to FHA field office.*
- *Bathroom—fixtures should be controlled by a wall switch not readily accessible from tub or shower. Locate electric bathroom heaters and control switches as far as practical from plumbing fixtures and at least 30 inches from tub or shower.*

TABLE 2. Amperage and wattage capacity of lead-in wires.

Service Wire Size	Amperes It Will Carry	Wattage Load This Will Handle	
No. 2 copper TW* or No. 2 aluminum THW**	100	24,000	(24KW)
No. 0 copper THW	125	30,000	(30KW)
No. 00 copper THW	150	36,000	(36KW)
No. 000 copper THW	200	48,000	(48KW)
No. 350 MCM copper THW	300	72,000	(72KW)

* Flame-retardant, Moisture-resistant, Thermoplastic

** Flame Retardant, Moisture & Heat-Resistant, Thermoplastic, dissipates heat better.

Postage Paid U.S.
Department of Agriculture

Agriculture and Home Economics
Experiment Station,
Iowa State University of Science
and Technology, Ames, Iowa 50010

Floyd Andre Director

Iowa Farm Science
Form IFS Permit No. 1116

POSTMASTER: Please return FREE
if unclaimed, See Postal Laws
and Regulations.

Wiring

Now to join the two—the need for electricity with the source of power. Understanding what goes into the cost of wiring is important to the home owner. Replacing a wiring system is costly and the time to do your wiring right is when you build or remodel.

The cost of wire is related to the size needed—and skimping only means shortening the life of your electrical system, your equipment and *perhaps you.* This is because of the hazards involved such as overheating inadequately sized wire.

The wire coming into the house is supplied by the power company, providing it's an overhead wire. In some cases, underground wiring is paid for by the home owner. The power supplier also furnishes the meter. But from the point of attachment to the house, you pay for the wiring system.

In times of copper scarcity, aluminum is less expensive for use in wiring. Although as yet little used for house circuits, it finds wide use out-of-doors especially for lead-in wires. Aluminum wire must be larger in diameter than copper wire in order to carry the same electrical load. In most instances the next size larger is used. Number 10 wire is equivalent to number 12 copper wire in current carrying capacity.

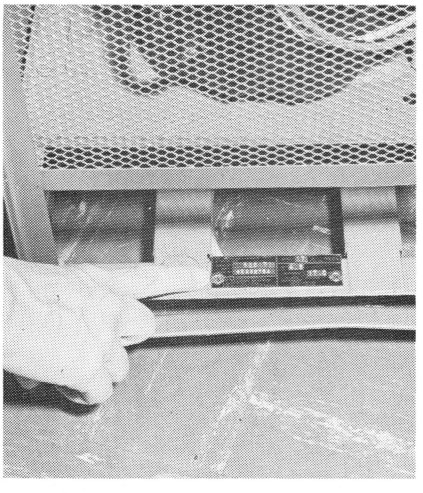
When aluminum lead-in wire is to be joined to copper or any other metal of the house system, special connectors must be used. It is advised that an alloy be used in the connector in order to separate the two metals, otherwise, the junction is subject to hazard producing corrosion.

When aluminum wire is to be used in the house circuits, it's use must be coupled with the use of outlets, switches and connectors that are adapted to it.

Wire sizes recommended for different amperage circuits are given in Table 3.

TABLE 3. Wire sizes for home electrical circuits.

No. 14 copper wire	for	15 amp. circuits
No. 12 copper wire	for	20 amp. circuits
No. 8 or 10 copper wire	for	water heaters and dryers (30 amp. circuits)
No. 6 copper wire	for	a range (50 amp. circuit)



WATTAGE of appliances is usually indicated on a small metal plate on the equipment. On some of the appliances, the wattage may be imprinted in the plastic case. You can check these plates to determine home wiring needs or make an estimate from Table I.

Because of the difference in the wire sizes needed for each wattage load, there's a difference in the cost of installing each electrical piece of equipment.

Electrical costs, like any other costs, vary at times with the material and labor costs. As of this writing, the following listed costs are intended only as a guide. In most instances the price stated is minimal for an average installation and the entire list is offered only to convey an idea as to how pricing is generally done. Call your local dealers for prices in your area. Here is our price guide:

Distribution Center or Service Panel	$115
Each duplex outlet	5
Each wall switch	5
Each fixture box	5
Each 3-way switch	7
Clothes dryer outlet	15
Range outlet (within 25 feet of panel)	20
Water heater outlet	15
Garbage disposer outlet	10
Dishwasher outlet	10
Range hood and fan	10
Doorbell chimes (small voltage transformer needed)	25

If you count up outlets, switches, fixture boxes and all, you can arrive at the approximate wiring costs of a new house.